

of the catalogues shows apparatus made by Messrs. J. J. Griffin and Sons for the purposes of instruction in sound, light and heat in schools and colleges. Among the new and ingenious devices contained in the catalogue we notice simple apparatus for the determination of the coefficient of linear expansion, the determination of relative conductivities, and a model theodolite. To make the catalogue of permanent use in the laboratory, tables are given of physical constants frequently required, and of logarithms, anti-logarithms and trigonometrical functions. The new catalogue of physical and electrical apparatus made by the Cambridge Scientific Instrument Company contains many instruments of precision not found in the lists of other instrument makers. For instance, a comparator and cathetometer combined, which can be used in a vertical or horizontal instrument, is described in the catalogue, and also geometric tripod stands, which can be so arranged as to form a stand of any desired height. Both these appliances were designed by Prof. C. V. Boys, and have not been illustrated previously. Other noteworthy instruments are a chronograph for laboratory use and the "Cambridge" standard coils, which are wound with bare platinum silver wire round a stout mica frame supported by a brass carrier. The coils are contained in a glass case with an ebonite top and are immersed in insulating oil. This arrangement ensures the coil being at the true indicated temperature, as there is no lagging due to paraffin wax or silk covering.

THE additions to the Zoological Society's Gardens during the past week include a Wedge-tailed Eagle (*Aquila audax*) from Australia, presented by Mr. Aubrey Richardson; two Spotted Turtle Doves (*Turtur suratensis*), a Barred Dove (*Geopelia striata*) from India, presented by Mr. L. Ingham Baker; a Common Bluebird (*Sialia wilsoni*) from North America, presented by Miss L. B. Dyer; five Prjevalsky's Horses (*Equus prjevalskii*) from Northern Mongolia, an Egyptian Jerboa (*Dipus aegypticus*) from North Africa, a Raven (*Corvus corax*), a Lapwing (*Vanellus vulgaris*), European, a Red-fronted Amazon (*Chrysotis vittata*) from Porto Rico, a Lesser Sulphur-crested Cockatoo (*Cacatua sulphurea*) from Moluccas, two Californian Quails (*Callipepla californica*) from California, five Yellow-winged Sugar-birds (*Coereba cyanea*), three Brazilian Tortoises (*Testudo tabulata*) from South America, a Long-necked Chelodine (*Chelodina longicollis*), a Bearded Lizard (*Amphibolurus barbatus*), a Gould's Monitor (*Varanus gouldii*), a Lace Monitor (*Varanus varius*) from Australia, twenty-four sharp-headed Lizards (*Lacerta dugesi*) from Madeira, deposited.

#### OUR ASTRONOMICAL COLUMN.

##### ASTRONOMICAL OCCURRENCES IN APRIL.

- April 2. 4h. Saturn in conjunction with moon. Saturn  $5^{\circ} 15' S.$
- 3. 9h. Jupiter in conjunction with moon. Jupiter  $5^{\circ} 53' S.$
- 4. 8h. 46m. Minimum of Algol ( $\beta$  Persei).
- 8. Sun eclipsed, invisible at Greenwich.
- 9. 15h. 51m. to 20h. 35m. Transit of Jupiter's Sat. IV.
- 10. Saturn. Outer minor axis of outer ring =  $13'' .96$ .
- 10. 16h. Ceres in conjunction with moon (Ceres  $0^{\circ} 23' N.$ ).
- 11. 9h. 36m. to 10h. 15m. Moon occults  $\delta^3$  Tauri (mag.  $4^{\circ} 2$ ).
- 12. 11h. 23m. to 12h. 11m. Moon occults  $\delta^1$  Tauri (mag.  $4^{\circ} 6$ ).
- 14. 12h. 36m. to 13h. 9m. Moon occults 68 Geminorum (mag.  $5^{\circ} 0$ ).
- 15. Venus. Illuminated portion of disc =  $0^{\circ} 435$ , of Mars =  $1^{\circ} 000$ .
- 15. 11h. 47m. to 12h. 17m. Moon occults 27 Cancri (mag.  $5^{\circ} 6$ ).
- 21. 11h. 46m. to 12h. 52m. Moon occults  $\alpha$  Virginis (mag.  $1^{\circ} 2$ ).

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- 22. 5h. om. to 8h. 45m. Moon eclipsed, partly visible at Greenwich. Moon rises at 7h. 5m. totally eclipsed.
- 23. 12h. Mercury in conjunction with Mars. Mercury  $0^{\circ} 40' S.$
- 23. 12h. 30m. to 16h. 12m. Transit of Jupiter's Sat. III.
- 24. 10h. 28m. Minimum of Algol ( $\beta$  Persei).
- 25. 10h. 53m. to 12h. 7m. Moon occults B.A.C. 5580 (mag.  $5^{\circ} 7$ ).
- 25. 12h. Venus at greatest elongation,  $46^{\circ} 12' W.$
- 26. 10h. 51m. to 15h. 40m. Transit of Jupiter's Sat. IV.
- 28. 16h. 20m. to 17h. 44m. Moon occults  $\rho^1$  Sagittarii (mag.  $3^{\circ} 9$ ).
- 29. 14h. Saturn in conjunction with moon. Saturn  $5^{\circ} 20' S.$

ORIGIN OF DISTURBANCE IN CORONA, MAY 17-18, 1901.—*Bulletin* No. 18 from the Lick Observatory is devoted to the discussion of more detailed examination of the photographs obtained during the total solar eclipse in Sumatra, which showed evidence of a marked disturbance in a certain region of the corona. A set of positives on glass from solar negatives taken at Dehra Dun, India, for the Solar Physics Committee, have since been received from the Astronomer Royal, giving exact records of the solar surface on May 17, 18, 19, 20, 21, 22, 26 and 28, 1901. The photographs of May 17 and 18 show no evidence of spots or other active features, but that for May 19 shows a medium-sized spot just passed into view round the east limb. On the 20th, this is seen to be followed by a group of smaller spots, surrounded on all sides except the west by a large area of faculae. This group of small spots shows conspicuous changes from day to day.

The positions of the spot on the plates of May 19 and 28 were measured, and from the reduced values its probable position on the day of eclipse was computed. It would be on the opposite side within  $4^{\circ}$  of the limb. The position angles of the spot as projected on the limb and the apex of the coronal disturbance are practically identical. As, moreover, both the sunspot and the coronal disturbance appear to have had the same latitude, it can hardly be doubted that this unusual appearance in the corona was in reality immediately above the group of sunspots and faculae, and that it had its origin in the same disturbance of the solar surface. In view of this conclusion, an attempt was made to determine if any measurable displacement of any of the coronal masses had occurred during the interval of about five minutes, but no certain indication of such motion could be detected. In this connection, however, the interval of one and a half hours between the times of eclipse in Mauritius and Padang should render a comparison of the negatives secured at the two stations valuable.

FOUCAULT'S PENDULUM.—An interesting announcement is made in the March number of the *Bulletin de la Société Astronomique de France* to the effect that a movement is being started among the astronomical authorities in Paris to arrange for the repetition of Foucault's famous experiment at the Panthéon, which was interrupted in 1851. No definite arrangements are yet settled, but it is hoped this majestic demonstration of the rotational movement of the earth will be successfully installed with all the advantages of modern refinements in instrumental construction.

#### A CONVENIENT TERMINOLOGY FOR THE VARIOUS STAGES OF THE MALARIA PARASITE.<sup>1</sup>

I HAVE found it necessary in labelling a series of models of the malaria parasite in the Central Hall of the Natural History Museum to use as simple and clear a terminology as possible. I think that this terminology will be found useful by others who are perplexed by such terms as "sporozoites," "blasts," "ookinetes," "schizonts," "amphonts" and "sporonts"—terms which have their place in schemes dealing with the general morphology and life-history of the group Sporozoa, but are not, as experience shows, well suited for immediate use in describing and referring to the stages of the malaria parasite.

It is necessary to treat the malaria parasite from the point of view of malaria; that is to say, to consider its significant phases

<sup>1</sup> By Prof. E. R. Lankester, F.R.S. Read before the Royal Society on March 6.

to be those which it passes in the human blood. In reality its mature condition and most important motile, as well as its most prolific reproductive, phases are passed in the body of the mosquito.

(1) The malaria-germ which is brought by the stab of the Anopheles into the human blood-vessels is a reproductive particle, a *spore*. It is needle-like in shape, and might be named in reference to its form (*e.g.* oospore or raphidiospore), but the most important fact about it for description and comparison is that it has been formed outside the human body, and is introduced as a strange element into the human blood by the agency of the mosquito. I therefore call it the EXOTOSPORE.

(2) The Exotospores (probably as many at a time as forty or fifty) enter the blood by the agency of the mosquito's stab and immediately penetrate, each one, a red corpuscle. The history of this process has not been observed. As soon as it has entered a red corpuscle the exotospore loses its needle-like shape and becomes amoebiform. I apply to it the name I proposed some years ago for similar amoebiform spores in other Protozoa, namely, AMOEBA ("Encyclopædia Britannica," article "Protozoa").

(3) The Amœba exhibits amoeboid movements within the red corpuscle, enlarges and finally breaks up into spherical spores, which are liberated with destruction of the red corpuscle.

It seems to me unnecessary to have a special name for the star-like or other condition of the Amœba when in course of breaking up into spores; but the spores so produced require a special name which shall emphatically distinguish them from the Exotospores. I call them the ENHÆMOSPORES, in reference to the fact that they are produced by a process of division which occurs in the blood of the malaria-stricken human being.

(4) The Enhæmospores penetrate fresh red blood-corpuscles, and after a certain growth as amoebæ break up into a new crop of Enhæmospores, by which the infection of the red corpuscles is extended. This process appears to go on for several generations and for a varying duration of time. But owing to conditions and at a period of the infection which has not been precisely ascertained, some (or all?) of the amoebæ derived from Enhæmospores cease to break up into spores. Instead of carrying out that process they enlarge, and in the case of the estivo-autumnal parasite (*Laverania praecox*) become sausage-shaped or, as it has been termed, crescent-shaped. This change of form is accompanied by a destruction of the red corpuscle and the formation of granules of dark pigment within the parasite. It seems best to term this phase the "CRESCENT" or "CRESCENT-SPHERE," the latter term being applicable to those species in which the form is not markedly crescentic.

(5) The crescents or crescent-spheres remain quiescent in the human blood. They are, however, of two different natures—male and female. It is not possible to distinguish with any certainty the male from the female crescents whilst they remain in the human blood-vessels. But it is these bodies which are destined to be swallowed by the Anopheles mosquito and to carry on further the life-history of the parasite.

The crescents are therefore the sexual phase of the parasite. When the crescents are swallowed by a mosquito (of an appropriate species), they undergo two different modes of development, determined by the fact of their sex. Both sexes become spherical, and may now be called respectively "EGG-CELL" and "SPERM-MOTHER-CELL."

From the periphery of the SPERM-MOTHER-CELL, now floating in the mosquito's stomach, there are developed with surprising rapidity six or seven SPERMATOZOA, which for a time remain attached to the residual mass (or SPERM-BLASTOPHOR) of the sperm-mother-cell. Complete cytological study of this development is still wanting, but it appears that the spermatozoa are true spermatozoa, like those of the higher animals, and have the same relation to the mother-cell from which they develop as is the case in such an animal as the earth-worm.

The EGG-CELL, now also floating in the mosquito's stomach, apparently gives rise to one, and possibly to two, polar bodies, but the observations on this point are, as yet, insufficient.

Fertilisation of the egg-cell now takes place in the gnat's stomach. A single spermatozoon penetrates and fuses with each egg-cell.

The fertilised egg-cell is spoken of as a "zygote"; it is also described as the sexually produced embryo.

(6) The ZYGOTE or SEXUALLY PRODUCED EMBRYO remains unicellular, but increases in size and becomes pyriform. It exhibits active movements of expansion and contraction in the

line of its long axis, and also a quick movement of its narrower end alternately to either side. This is the largest growth of the individual cell attained to in the series presented by the life-history of the malaria parasite. It has been called "vermiciform" and "vermicule" (Ross), and I adopt this name for it, viz., the VERMICULE. The vermicule is the dominant individual form in the history of the malaria parasite, endowed with greater size, power and activity than other phases. It corresponds, not only in this respect, but also in its position in the life cycle, to the large often active cells of the Gregarinidea, which I proposed some time ago to call the Euglena-phase ("Encyclopædia Britannica," article "Protozoa").

It is worthy of note that in the size and activity of the vermicule, the Haemospordia—the order of Sporozoa which embraces the malaria parasite—come nearer to the Gregarinidea than they do to the Coccidiidae, though in the existence of a sexual generation absent in Gregarinidea they agree with the Coccidiidae.<sup>1</sup>

The vermicule now pushes its way through the tissues of the gnat's stomach and in the blood sinuses outside the stomach becomes spherical. It enlarges and nourishes itself on the insect's blood, and forms a spherical CYST, or structureless transparent envelope. This cyst is destined to enlarge, with vast increase of its living contents.

The living cell within the cyst breaks up by a definite process to form eventually an immense number of exotospores, the stage with which the present description commenced. The CYST would most conveniently be called a "sporocyst," since, as so often happens in Protozoa, it is formed purely and simply in relation to the quiescence of the organism and its division into numerous reproductive spores. Unfortunately, the word "sporocyst" has been employed recently by writers on the Sporozoa for the small capsules containing one or two to eight elongated spores which used to be called "pseudonavicular," and are formed within such larger cysts as that now in question. The word "cyst" should have been reserved for the larger more general protective envelope, and the "pseudonavicular" might have been called "sporo-thækæ." In any case, I think we may call the cysts in which the vermicules of the malaria parasite enclose themselves "SPORE-CYSTS" or "SPORE-FORMING CYSTS." The name "oocyst," applied to them by some writers, is simply misleading.

(7) The spore-cysts lying outside the stomach wall of the mosquito bathed in the insect's blood receive abundant nourishment. The single-celled vermicule enclosed undergoes rapid changes; it increases greatly in volume and breaks up by normal cell division (? the earliest steps have yet to be studied) into a number of SPORE-MOTHER-CELLS. In the process of this division and the later stages of the final development of the "spores" (exotospores), the "spore-forming cyst" increases in size to twenty times its initial diameter.

The spore-mother-cells are set closely together in the cyst; they are of polygonal shape, owing to pressure, and each has its nucleus. Finally they give rise, each spore-mother-cell, to a crop of filiform spores (exotospores) which have the same relation to the spore-mother-cell as spermatozoa have to a sperm-mother-cell, viz., they form on the outside of the spore-mother-cell as outstanding processes, carrying away all the chromatin of the mother-cell and leaving in the centre or to one side a "residuary body," a "spore blastophore" similar to the "spermblastophore" of spermatozoon-development.

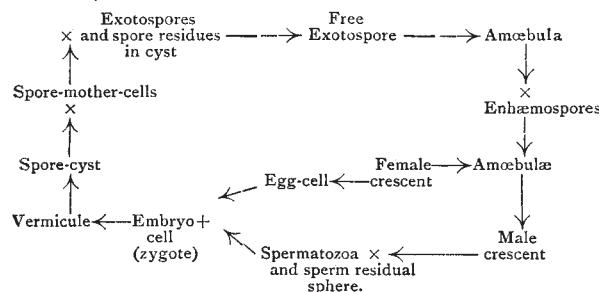
Thus we are brought back to the needle-like exotospores with which we started.

The spore-holding cysts burst and liberate the exotospores into the blood of the mosquito. Thence they readily pass into the ducts of the salivary gland, and so are conveyed by the mosquito's stabbing beak into human beings. A point in this connection is the definite ejection by the mosquito of the secretion of its salivary gland into the punctured wound which it makes in the human skin. There can be no doubt that such an ejection takes place. The leech ejects a secretion on to the wound caused by its bite which has the property of preventing the coagulation of the blood. It is possible that the mosquito and other blood-sucking flies may use the salivary secretion for the same purpose. It is obvious that unless there were some injection into the wound on the part of the fly, the chances of

<sup>1</sup> A sexual phase has been described in the Gregarine Stylohyphus by Léger since this paper was written. It occurs at an unexpected point in the cycle: two encysted full-grown "Sporonts" are stated to produce the one egg-cells the other spermatozooids.

infection of the bitten animal by the parasites carried by mosquitoes or tsetze fly would be very small.

Our cycle of forms with the names here made use of may be written as below. The sign  $\times$  is used to indicate fissile multiplication, and + to indicate fusion, while  $\rightarrow$  merely indicates continuity.



I also give a list of the names here used with reference to the occurrence of the forms indicated in man or in gnat and an indication of the corresponding stages in a Gregarina and a Coccidium. In the column belonging to Coccidium I have employed the generalised physiological nomenclature accepted by special students of the Sporozoa (Schaudin, Lühe, &c.).

Malaria.	Coccidium.	Gregarina.
1. Exotospore, free in human blood ("Blast" of some authors.)	Sporozoite	Sporozoite. (Filiform young.)
2. Amœbulæ, in red corpuscles	Schizont	Amœbulæ.
3. Enhæmospore, ditto, and in blood	Merozoites, formed by schizogony.	
4. Crescent, in human blood	Gametocytes	
a. Male	Microgametocyte	
b. Female	Macrogametocyte	
5. Sperm-mother-cell, in gnat's stomach	Microgamete	
6. Egg-cell, in gnat's stomach	Macrogamete	
7. Spermatozoon, in gnat's stomach	Microgamete	
8. Zygote or embryo-cell, in gnat's stomach	Young oocyst (sporont)	
9. Vermicule, in gnat's stomach	WANTING (Called "ookinete" or "kinetosporont" in the nomenclature of this column.)	Full-grown motile "gregarine." (Euglenoid phase.)
10. Spore-cyst, in blood-sinus outside gnat's stomach	Older (but not larger) oocyst or sporont	Cyst enclosing one or two full-grown sporonts.
11. Spore-mother-cells in cyst, in blood-sinus outside gnat's stomach	Sporoblasts (sporogony)	Sporoblasts. (? Conjugation in <i>Lankesteria Ascidia</i> . Spermatozoa and ova in <i>Stylocyphus</i> .)
12. Exotospores in cyst, in blood-sinus outside gnat's stomach	Sporozoites enclosed in small groups in sporocysts within the bigger oocyst.	Sporozoites enclosed in capsules, called "pseudonaviculae" or "sporocysts."
21. Free exotospores, in gnat's salivary duct	Free sporozoite	Free sporozoite.

#### UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE proposals of the Government with respect to education in England and Wales were described in the House of Commons by Mr. Balfour on Monday, and after a discussion, leave was given for the introduction of the Government Education Bill. It is proposed that in future there shall be one authority for education, primary, secondary, and technical; and that this authority, being responsible for a heavy cost to the ratepayers, shall be the rating authority for the district. Explaining the broad outlines of the measure, Mr. Balfour stated that the education authority will be the county council in counties and the borough council in county boroughs. They will work through committees appointed under schemes which will have to be approved by the Education Department. A majority of a committee at least is to be appointed by the council. The other members are to be nominated, and to be persons experienced in education. Wales, which has a secondary education authority already, is to be permitted either to retain that authority or to substitute for it the authority proposed in the Bill. With regard to secondary education, the provisions of the measure are practically identical with those embodied in the Bill of last year. County councils and borough councils are to have a 2d. rate to work upon, and as in many places that will be insufficient,

power will be given to have that limit raised by provisional order. Boroughs already possess a certain jurisdiction over technical education, and have a rate of 1d. to work upon. It is not proposed to deprive any borough with a population above 10,000, or any urban district with population above 20,000, of that jurisdiction. The councils of these boroughs and urban districts may, if they choose, become the absolute authority over primary education. They would retain their existing powers over technical education, and would become the authority for secondary education concurrently with the county council. But whether the schools in a district are voluntary or rate erected, the local educational authority created by the Bill will in future be the absolute master over all secular education. London is excluded from the operation of the Bill. The adoption of the elementary education portion of the measure would, for a time, be optional.

MR. H. BRERETON BAKER, M.A., late scholar of Balliol College, Oxford, has been elected by the governors of Dulwich College to be headmaster of Alleyn's School, Dulwich. Mr. Baker, who has had several years' scholastic experience as senior science master in Dulwich College, is well known as a chemist of real distinction, whose important papers in the *Philosophical Transactions* and the *Journal of the Chemical Society* on the remarkable influence of traces of moisture in facilitating chemical action have attracted well-deserved attention. Physical science has long formed a prominent part of

the course at Alleyn's School, which possesses physical and chemical laboratories that are probably not surpassed by those of any school in the country. It will be a matter of interest to scientific men that at least one school in the kingdom should be, not only well provided with laboratory accommodation, but should have at its head a man of acknowledged scientific reputation.

SIR PHILIP MAGNUS will preside at a public meeting to be held in connection with the conference of the National Association of Manual Training Teachers at Manchester on Easter Tuesday, April 1.

THE Government of India has had under consideration the improvement of the existing system of education of Europeans and Eurasians, and the Local Governments have been asked for an expression of their views upon the subject. Meanwhile (says the Allahabad *Pioneer Mail*) a small committee of educational officers has been appointed to examine and revise the Bengal Code of Regulations for European Schools, in the hope that it may be found possible to render it suitable for adoption throughout India. The Secretary of State has accepted the proposal of the Government of India to create an appointment of Director-General of Education in India, and Lord George Hamilton has selected Mr. H. W. Orange to fill the post.